

concentrations. The chloride concentrations were used to correct for in-stream dilution, permitting calculation of net downstream changes in nutrient concentrations.

The waters of the receiving streams usually had low concentrations of chloride and nutrients. The effluent generally increased these parameters just below the outfall, but concentrations decreased again downstream more rapidly than expected from dilution alone. Such decreases which exceed the rate of simple dilution represent net nutrient removal. Median net removal efficiencies for ammonium, total N, phosphate, and total P within about 4 km of the Rich Square and Scotland Neck outfalls ranged from about 50% to 100% of the amounts in the effluent. About 80% of the nitrate was removed in the Deep Creek wetland below Scotland Neck. Rich Square effluent had very low concentrations of nitrate; nitrate changes relative to the amount in the wastewater ranged from very high to very low, with the median showing no significant change below the outfall. The data base was smaller, but the sites in the extensive study also showed a pattern of net nutrient removals in the swamp-stream systems below the outfalls. Ammonium removal was generally poor and inconsistent at the extensive sites, especially where effluent concentrations were relatively low.

The efficiencies of nutrient removal at the intensive sites were generally similar to removals which have been measured in other N.C. Coastal Plain swamp streams. Furthermore, these results generally agreed with results from other Southeastern states that riparian wetlands effectively trap sediments and nutrients from agricultural and municipal sources, delaying and reducing their transport to the coast.

## RECOMMENDATIONS

### General Recommendations

Good water quality in North Carolina estuaries is important because of their economic, recreational, and aesthetic values. The forested bottomlands and swamps along Coastal Plain streams are dynamic multipurpose natural areas. Because of demonstrated capabilities of riparian forested wetlands to reduce nutrient loadings to the estuaries, it is critical that both the areal extent and the functional properties of the riparian wetlands be maintained. They must be protected particularly from channelization and conversion to farmlands, a process which effectively destroys them. Consideration must also be given to protection from adverse changes to vegetative structure and soil properties, for example through unwise forestry practices, which will decrease nutrient removal capabilities. Finally, the riparian forested